JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2012, **45,** 229–240 NUMBER 1 (SPRING 2012)

REVIEW OF HEYMAN'S ADDICTION: A DISORDER OF CHOICE

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Gene Heyman's *Addiction: A Disorder of Choice* (2009) advances the important, albeit controversial, view that addiction is not a chronic, relapsing brain disease, but instead is an example of typical everyday choice that is both voluntary and self-destructive. This review highlights Heyman's arguments for conceptualizing addiction as choice and discusses the utility of the treatment implications that are derived from the melioration model in which Heyman frames addiction. Self-control and behavioral economics are presented as additional complementary frameworks for understanding addiction as choice, from which pragmatic, evidence-based treatments for addiction (e.g., contingency management) might more easily be derived.

Key words: addiction, operant behavior, self-control, behavioral economics

In the context of ever-growing popular support for a disease model of addiction, Heyman's *Addiction: A Disorder of Choice* (2009) argues that addiction results from normal, albeit suboptimal, everyday decision making. Contrary to a conception of addiction as a chronic physical condition like diabetes or asthma, Heyman views addiction as voluntary operant behavior that results from a temporally myopic view of the available alternatives in a choice situation. The temporally myopic drug user devalues the delayed aggregate of better health, financial stability, and secure relationships that accompanies abstinence, and predictably chooses to use drugs. Heyman's view is more nuanced, of course, and controversial. The controversy stems largely from the way that many nonbehavioral scientists, policy makers, and laypeople understand addiction and voluntary behavior. This book is appropriate for laypeople and scientists alike, but the context in which Heyman frames addiction makes the book especially appropriate for graduate students in psychology. In addition, Heyman's discussion of solutions may appeal to other individuals (e.g., medical students) who work with drug addicts, as well as policy makers who seek effective drug-control policies. Heyman obtained his doctorate in experimental psychology at Harvard University under the mentorship of Richard Herrnstein.

Although the notion of addiction as choice will not be foreign to *JABA* readers, a brief explanation of the disease model is worthwhile. The disease model holds that addiction is a chronic, relapsing brain condition that causes compulsive drug seeking and drug using despite harmful consequences to both the user and those around him or her (National Institute on Drug Abuse [NIDA], 2008). NIDA (2008) views addiction as a brain disease because it produces structural and functional brain changes. The controlling variables emphasized in the disease model are biological. These variables include genetic factors that predispose individuals to compulsive drug use (Crabbe, 2002; Crabbe, Belknap, & Buck, 1994; Kreek, Nielsen, Butelman, & LaForge, 2005), and brain changes that occur during the transition from drug use to drug addiction (Goldstein & Volkow, 2002; Hyman & Malenka, 2001; Nestler, 2001). For example, Kalivas and O'Brien (2008) suggested that the neural underpinnings for the transition from drug use to drug addiction involve a shift in neural circuitry: from reliance on the circuitry that

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doi: 10.1901/jaba.2012.45-229

underlies voluntary behavior to the circuitry that underlies involuntary behavior. Specifically, declarative and executive prefrontal circuitry underlie voluntary behavior, whereas procedural memories that drive the unconscious performance of well-learned behavior underlie habit circuitry (Barnes, Kubota, Hu, Jin, & Graybiel, 2005; Everitt & Robbins, 2005). According to this account, addiction occurs when the circuitry that controls behavior shifts from voluntary to involuntary. Throughout this review, we hope to convey that, although such brain changes have been shown to underlie addiction, this does not necessitate that brain changes *cause* addiction to occur.

SETTING THE STAGE: HISTORY, EPIDEMIOLOGY, AND FIRST-PERSON ACCOUNTS OF ADDICTION

Heyman begins with a historical review of how society has responded to drug addiction, and how society currently responds to the problem both medically and legally. Heyman notes the cultural disconnect that, despite the widespread (and increasing) acceptance of addiction as a disease, the judicial system continues its heavy involvement in responding to addiction-related issues. In fact, Heyman notes that addiction is the only disorder associated with both an actual and a metaphorical military action (i.e., the invasion of Panama to capture Manuel Noriega and the "war on drugs"). In addition, addiction is the only psychological disorder with symptoms that can be punished by law (e.g., the criterion of "compulsive drug seeking" inherently entails buying and possessing drugs).

After pointing out society's tendency to dichotomize the causes of addiction (i.e., as either a chronic, relapsing brain disease or as willful, societally damaging behavior), Heyman notes an important consequence of this dichotomy: These views imply contradictory treatment approaches. Specifically, Heyman states that if addiction is a disease, and if diseases should be treated, then punishing addicts for drug use will be relatively ineffective. Conversely, if addiction is a choice, then treating addicts in programs that fail to impose consequences for addiction-related behaviors will be relatively ineffective.

These dichotomous approaches fail to represent the vast body of methods that are available for combating addiction. However, when the medical and naive choice views of addiction are abandoned in favor of the choice view proposed by Heyman, other methods for combating addiction emerge. Heyman's argument is that the temporally myopic drug user makes voluntary self-destructive choices as a function of contextual variables. In other words, addiction is self-destructive operant behavior. If this is true, then one approach to combating addiction that can be extrapolated from Heyman's view is to manipulate the contextual variables that produce self-destructive behavior. If Heyman's argument is correct, then manipulating these variables should lead the individual to perform health-promoting behaviors in the future (or avoid self-destructive behaviors in the present). It is important to note that this approach to addiction does not necessitate medical interventions or legal repercussions.

After discussing the incompatible solutions that society commonly employs to combat addiction, Heyman presents the results of several epidemiological studies that highlight the limitations of the disease model of addiction. For example, data from the 2002 National Survey on Drug Use and Health (Substance Abuse and Mental Health Services Administration [SAMHSA], 2003) and the National Epidemiological Survey on Alcohol and Related Conditions (NESARC; Conway, Compton, Stinson, & Grant, 2006) show that the majority of individuals who experiment with various illicit drugs do not become addicts. Heyman does not present this data in order to disregard the corpus of research that documents the brain changes that occur during drug use. He simply

attempts to convey that the association between drug use and structural and functional brain changes does not necessitate that brain changes *cause* a chronic, relapsing condition. We should emphasize here that the notion that a choice view denies biological contributions to addiction is an important and unfortunately common misconception. In fact, Heyman makes the point several times throughout his book that his view of addiction as choice does not exclude neurophysiological influences.

Although experimenting with drugs undoubtedly causes brain changes, our interpretation of the SAMHSA and NESARC data discussed above is that these brain changes are not both necessary and sufficient to turn an individual into an addict; other variables must also contribute. Some of these variables are implied in Heyman's presentation of Robins and Regier's (1991) data showing that the likelihood of being a drug addict differs as a function of one's year of birth. Substance abuse or dependence is the only psychiatric disorder that was 13 times more probable as a function of whether one was born between 1917 and 1936 (less likely), or between 1952 and 1963 (more likely). Aside from differing as a function of cohort, the likelihood of substance abuse or dependence also differs as a function of the income level of one's neighborhood (Brownsberger, 1997). We have interpreted these patterns as suggesting that, although brain changes underlie the development of addiction, the controlling variables for addiction are not solely biological.

Shifting from broad epidemiological trends to first-person accounts, Heyman presents the histories of current and former drug addicts in the form of unstructured interviews. Although these anecdotes do not constitute empirical support for the notion of addiction as choice, they embody relevant behavioral principles that are responsible for abstinence. For example, one former drug user ceased using cocaine because she identified her behavior as being incompatible with her role as a PTA president. Another former addict quit cold turkey when her drug habit left her choosing between an immediate drug-induced high or saving money to feed her daughters. A third quit when she was overcome by the desire for her parents to be proud of her again. Although not stated explicitly by Heyman, the principle of alternative reinforcement is embodied in these accounts. Specifically, when alternative drug-free reinforcers are both available and sufficiently valuable to compete with the value of drugs, an individual is more likely to abstain from drug use.

Heyman returns to epidemiological data to flesh out the natural history of addiction. He presents data from the Epidemiological Catchment Area Study that show high rates of spontaneous recovery among drug addicts (Anthony & Helzer, 1991). In fact, more than 80% of addicts recover on their own. These data corroborate the anecdotes above in which individuals spontaneously recovered from their addictions without medical help. Moreover, these data support the broader message that Heyman conveys in this chapter, which is that recovery is not a rare outcome of addiction that occurs in a lucky few: It is a typical event experienced by most addicts at some point during the course of their addiction.

ADDICTION AS CHOICE

In addition to presenting epidemiological research and first-person accounts, Heyman employs two other strategies to further emphasize the view of addiction as choice. First, he criticizes the logic that underlies the view of addiction as a disease. Second, he presents an alternative behavioral model of choice that accounts for the addict's myopic decision to use drugs.

Heyman addresses one line of reasoning that underlies the disease view in a chapter titled "Behavior, Disease, and Addiction." This line of reasoning is as follows: (a) Self-destructive behavior implies illness, and because (b)

addiction is self-destructive, (c) addiction must be an illness, thus (d) addicts must seek help at a clinic in order to recover. Heyman's primary means of deconstructing this line of reasoning is to question the tendency to assume that *self-destructive* implies involuntariness. Contrary to this commonly held assumption, Heyman suggests a revision in assumptions about addiction (i.e., addiction is voluntary rather than involuntary). Specifically, Heyman emphasizes that word meanings are not set in stone; they change as a function of experience. Consequently, if we define *voluntary behavior* as behavior that is not self-destructive, then *voluntary* means "not self-destructive." Alternatively, if we redefine *voluntary* so that it can include self-destructive behavior, then the line of reasoning falls apart. If *voluntary* now encompasses self-destructive behavior, then it no longer follows that addiction must be a disease. In addition, the previously described data showing that most addicts recover on their own invalidates Step D: Addicts do not need clinics to recover.

Although genetic factors have been shown to influence drug addiction (George & Goldberg, 1989; Nestler, 2000), Heyman notes that one common error made by both laypeople and scientists is to assume that genetic involvement in a behavior implies that the behavior is involuntary. Heyman discusses data that show high correlations in religious values and practices between identical twins reared apart, whereas there are no correlations in religious values and practices between fraternal twins reared apart (Waller, Kojetin, Bouchard, Lykken, & Tellegen, 1990). Heyman acknowledges that these data constitute evidence for genetic contributions to religious behavior, but questions whether many people would regard religious values as involuntary. Similarly, we previously noted that activity in different brain areas occurs with regulated as opposed to compulsive drug use (e.g., Kalivas & O'Brien, 2008). Although such findings represent evidence of neural involvement in drug use and drug addiction, they do not imply that brain activity causes drug use: The brain is involved in all operant behavior (Fox & Rudell, 1968; Robbins & Everitt, 1996; Wise, 1996).

Although Heyman acknowledges that neural variables influence addiction, he does not specify how neural variables can be incorporated into a functional analysis of operant behavior. Thompson (2007) argues that neural variables can serve as establishing operations, antecedent stimuli, and reinforcers in an experimental analysis of behavior. Consequently, one might imagine that the neurobiological mechanisms involved in tolerance (e.g., receptor downregulation of involved brain neurotransmitter systems; Dackis & Gold, 1985) and sensitization (e.g., receptor upregulation of these systems; Unterwald, Ho, Rubenfeld, & Kreek, 1994) serve as abolishing and establishing operations, respectively, by altering (in a quantitative fashion) the value of drugs with extended use. This progression does not necessitate the development of a qualitatively new form of behavior with new controlling variables, as is implied by disease models that posit a shift from executive to habit circuitry and by models that posit that a switch is thrown at some point in the transition from drug use to drug addiction (e.g., Leshner, 1997, 2001). Instead, brain changes might function as establishing operations that alter the reinforcing value of drugs (e.g., drugs might be more reinforcing in a low dopamine state than in a high dopamine state), thus altering the probability of future drug use.

After discussing the logical flaws associated with the disease model, Heyman presents a model for conceptualizing addiction as choice. He explains his view of addiction as a choice between an immediate, singular consequence (e.g., cocaine now) or a delayed "market basket" of consequences (e.g., an aggregate of improved health, financial security, and stable relationships). Choosing the former rather than the latter is due to a difference in "bookkeeping."

Local bookkeeping is synonymous with Herrnstein's (1970) matching law, which states that the proportion of behavior matches the proportion of reinforcers received for performing each behavior. When one chooses from a local bookkeeping perspective, he or she chooses the option that, at the moment of choice, yields the highest value. This is referred to as *melioration* (Herrnstein & Prelec, 1992).

In contrast to local bookkeeping, global bookkeeping entails occasionally forgoing the higher value obtainable from one option at the moment of choice. Rather than choose the high-value option, global bookkeepers make a series of temporarily lower value choices so that in the long term, the value derived from the delayed aggregate is greater than the value that would be derived if the locally preferred option were chosen each time. With respect to drug addiction, Heyman views the addict as making choices in accordance with local rather than global bookkeeping. In other words, with each singular opportunity in which one chooses either drugs or abstention, using drugs will yield a higher value than abstaining. However, this is only the case from the local bookkeeping perspective. Viewed from the global bookkeeping perspective, in which the choice to use drugs represents a choice between competing lifestyles (i.e., life as a user or a nonuser), one should never use drugs because the overall value of a drug-using lifestyle stabilizes at a suboptimal level of value relative to a drug-free lifestyle.

Heyman exemplifies melioration by describing two 30-day scenarios, one depicting the value at which choice stabilizes when an individual uses drugs every day, and the second depicting the value at which choice stabilizes when an individual remains abstinent for 30 days. Viewed from the perspective of the temporally myopic drug user, the better day-to-day choice (i.e., the option that yields the higher value at the moment the decision is made) is to use drugs. However, successive drug choices cause the drug to lose value each time it is chosen (due to processes such as increased tolerance) and causes most nondrug activities to lose value as well (e.g., one's ability to participate in social and work-related activities is compromised). Viewed from the perspective of the global bookkeeper, the decision is not whether to use drugs any given day, but whether to live life as a user or as a nonuser. Given that the value at which choice stabilizes in an abstinent lifestyle is higher than that at which choice stabilizes in an addict's lifestyle (i.e., health, finances, and secure relationships are preserved), the better option from this perspective is 30 days of abstinence.

MODELS, PRAGMATISM, AND BEHAVIOR CHANGE

The combination of data and hypothetical examples that Heyman presents in the chapter titled "Addiction and Choice" demonstrates the utility of melioration as a model for understanding addiction as choice. However, the abstractness of both the model and the solutions derived from it might diminish the force of the argument for addiction as choice. In addition, the model raises as many questions as it answers (e.g., how do clinicians promote global bookkeeping, what types of individual experiences promote global bookkeeping, etc.). There are, however, alternative, empirically derived models of decision making that have enjoyed success in uncovering the determinants of choice. These alternative frameworks, in addition to Heyman's melioration framework, collectively make a more straightforward and pragmatic case for addiction as choice.

Heyman proposes that if addiction is a problem of local bookkeeping, then individuals must be taught economic rationality to decrease the frequency of drug use. In other words, teaching individuals how to make choices from a global bookkeeping perspective should lead them to choose abstinent lifestyles. Although this solution is a theoretically appropriate extrapolation based on the melioration model,

it is difficult to ascertain precisely what teaching global bookkeeping or economic rationality entails.

Heyman's examples of teaching economic rationality take the form of two laboratory experiments. In the human laboratory experiment (Kudadjie-Gyamfi & Rachlin, 1996), college students played a choice game in which they pressed one of two buttons over a series of trials. Pressing one button awarded more money on current trials but reduced the total sum that was earnable in the future (the better choice from the local bookkeeping perspective). Pressing the other button maximized the total sum that could be earned overall (the better choice from the global bookkeeping perspective). Students' behavior differed as a function of how choice was presented: When individual trials were separated by fixed durations of time (10 s), students chose according to local bookkeeping. Conversely, when choices were presented in threes (i.e., as aggregates) and were separated by longer durations (30 s), choice shifted towards global bookkeeping. Although these data demonstrate that humans can be taught to make profitable choices under controlled laboratory conditions, the implications for teaching economic rationality in natural environments are unclear. In the case of addiction, it would be neither feasible nor ethical to repeatedly expose an individual to the consequences associated with choosing to use drugs as opposed to choosing abstinence.

In addition to the fairly broad proposal that teaching economic rationality would decrease addiction, Heyman proposes several specific solutions. Although these solutions are easier to understand than teaching economic rationality, it is more difficult to discern how they are derived theoretically from a melioration model. For example, based on data that show a high correlation between being married and not using drugs (Robins & Regier, 1991), Heyman labels marriage "the antidrug relationship." Although not stated explicitly, our opinion is that this argument implies the higher order organizing principle of alternative reinforcement (or contingencies that support behavior that is incompatible with drug use). Marriage is an example of an alternative source of reinforcement with a reinforcing value that might effectively compete with that of drug use. Other variables that have been shown to correlate with limited drug use include the region where one lives (e.g., drug use is more common in impoverished and rural areas), higher grades, fewer truancies, an increased number of hours worked per week, and an active social life (Bachman, Johnston, & O'Malley, 1981). In addition to marriage, expanding the range of abstinence-promoting variables highlights the general principle that any alternative source of reinforcement that competes with drug use in terms of its reinforcing value should reduce use. Moreover, the link between abstinence-promoting variables and reduced substance use might be more easily explained in terms of the higher order organizing principle of alternative reinforcement rather than in terms of melioration.

Heyman also discusses the effectiveness of Alcoholics Anonymous (AA) at promoting sobriety. Like marriage, AA is a more clearly defined solution than teaching economic rationality, but it is unclear how it is derived from melioration. Instead, it seems that the efficacy of AA can be explained more easily in terms of basic behavioral principles. First, AA permits one to use self-control techniques to manipulate the variables that control excessive drinking. For example, if one's goal is to control his or her alcohol intake, he or she is encouraged to manipulate the environmental antecedents that precede drinking. AA often accomplishes this by providing new members with a mentor from whom they may seek counsel if they find themselves in the presence of discriminative stimuli for drinking. Another likely reason for AA's effectiveness is that meetings themselves are a substance-free source of alternative reinforcement, and, as we have emphasized repeatedly, the

presence of valued, substance-free reinforcers in one's environment has been shown to reduce drug use. Other therapeutic elements of AA may include the diminishing of the immediate positive consequences associated with drinking (e.g., new social contingencies may cause embarrassment about a relapse) or an increase in the salience of the delayed outcome (e.g., members may contemplate the improved health that accompanies abstinence).

In sum, although melioration is a useful framework for understanding addiction as choice, the solution of teaching economic rationality that extends logically from melioration is abstract, and it is unclear how it would be implemented in a naturalistic setting. Moreover, although Heyman presents more concrete solutions to curtailing addiction (i.e., marriage and AA), these solutions are more difficult to situate in a melioration framework. In the following, we present two frameworks that complement melioration and that suggest practical, evidence-based treatments for addiction that might be easier to implement by behavior analysts and practitioners. Aside from the pragmatic treatment implications of the frameworks discussed below, another benefit is that the efficacy of the solutions proposed by Heyman can be explained more easily in the context of these frameworks than in a melioration framework.

One example of a clearly defined framework in which addiction can be understood as choice is by referring to addiction as a problem of self-control. Conceptualizing addiction in this manner entails that one is familiar with delay discounting, which refers to the loss in subjective value of a commodity as the temporal delay to receipt of that commodity increases (Ainslie, 1974; Green, 1982; Mazur, 1987). In typical delay-discounting procedures, humans or nonhuman animals choose between a smaller immediate reinforcer and a larger delayed reinforcer. Impulsive choice refers to choosing the former, whereas self-controlled choice refers to choosing the latter (Rachlin, Raineri, & Cross, 1991; Reynolds, 2006). When applied to drug use, self-control means choosing the delayed benefits of abstinence rather than the immediate reinforcement provided by one's drug of choice. Individuals who use cigarettes, alcohol, marijuana, cocaine, or heroin discount the delayed value of money, as well as their substance of choice, more steeply than nonusers (Baker, Bickel, & Johnson, 2003; Critchfield & Kollins, 2001; Kirby, Petry, & Bickel, 1999; Madden & Bickel, 2009; Rosenthal, Edwards, Ackerman, Knott, & Rosenthal, 1990), suggesting that these individuals often fail to engage in self-controlled behavior.

Strategies to promote self-controlled choice include diminishing the value of the immediate reinforcer (e.g., imposing more aversive consequences for drug use), decreasing the delay until receipt of the delayed reinforcer (e.g., permitting oneself to splurge on a movie at the end of a drug-free week), increasing the salience of the delayed reinforcer (e.g., reflecting on the long-term benefits of abstinence), or manipulating the variables that contribute to impulsive choice (e.g., committing to substance-free weekend plans early in the week so that drinking at a bar becomes less probable). Although Heyman identifies impulsivity as a ''predrug individual difference'' that might lead some individuals to make drug-related choices from a local bookkeeping perspective, he does not frame addiction in terms of impulsivity versus self-control. Consequently, solutions that can be derived easily from understanding addiction this way are not discussed. For example, the notion that decreasing the delay until receipt of the delayed reinforcer can promote abstinence helps explain the effectiveness of one important evidence-based behavioral treatment for addiction: contingency management (CM). Although Heyman discusses CM in his book, it is not presented as a treatment that is based directly on the framework in which he conceptualizes addiction as choice.

CM allows patients to earn monetary incentives exchangeable for goods and services in the community, contingent on their meeting

biochemically verified abstinence goals (Higgins, Alessi, & Dantona, 2002; *JABA*, 2008; Lussier, Heil, Mongeon, Badger, & Higgins, 2006). Since its introduction, CM has been used to promote abstinence among users of opiates (Bickel, Amass, Higgins, Badger, & Esch, 1997), alcohol (Petry, Martin, Cooney, & Kranzler, 2000), cigarettes (Dallery, Glenn, & Raiff, 2007; Donatelle, Prows, Champeau, & Hudson, 2000; Roll & Higgins, 2000), and marijuana (Budney, Higgins, Radnovich, & Novy, 2000). For example, Dallery et al. (2007) employed Internet technology that allowed smokers seeking treatment to submit breath carbon monoxide (CO) samples via a Web camera. Breath CO provides an index of recent smoking, and if this index was below a predetermined abstinence criterion, participants received vouchers exchangeable for goods and services (e.g., Amazon, Best Buy, etc.). This program produced high rates of abstinence, and use of the Internet-based system eliminated several common problems associated with treatment delivery (e.g., limited transportation to treatment centers). The success that CM has achieved attests to the enormous strides that behavior analysts have made in treating addiction. Although Heyman discusses CM in his book, he does so primarily to illustrate the notion of addiction as choice. Thus, although CM (in theory) could be derived from a melioration model (e.g., reinforcing every nondrug choice presents the temporally myopic user with two options in which the better choice is no longer necessarily using the drug), it is not discussed as a treatment implication based on melioration.

Another useful framework for understanding addiction as choice is behavioral economics. The field of behavioral economics is the marriage of economics and operant psychology, and behavioral economists employ concepts from both fields to describe and predict an organism's allocation of resources (e.g., money, time, behavior) as a function of environmental constraints (Murphy, Correia, & Barnett, 2007). When extended to human operant behavior, research shows that drug use is linked reliably to response cost, availability of substance-free reinforcement, and the reinforcement value derived from drug relative to drug-free activities (Bickel & Marsch, 2001; Murphy et al., 2007).

Response cost refers to any losses (e.g., financial, legal, social, health) associated with drug use, and research shows that increases in the cost of drug use contribute to decreased consumption (Murphy & MacKillop, 2006). For example, increased drink prices on college campuses contribute to reductions in drinking (Murphy et al., 2007). Murphy et al. suggested several strategies for diminishing alcohol use among college students, including raising the monetary cost of alcohol, banning alcohol on college campuses, increasing the cost of liquor licenses, and intensifying the natural negative consequences of binge drinking (e.g., increasing mandatory class time so that the "cost" of a hangover is greater than it would be if the student could spend the day in bed).

Another controlling variable that behavioral economists link to drug use is the availability of substance-free reinforcers. There is an inverse relation between the amount of substance-free reinforcers in one's environment and the frequency of drug use (Carroll, 1996; Griffiths, Bigelow, & Henningfield, 1980; Van Etten, Higgins, Budney, & Badger, 1998). This relation has been observed in animal studies in which behavior such as saccharin consumption (Cosgrove & Carroll, 2003), social access (Cain, Saucier, & Bardo, 2005), and exercise (Cosgrove, Hunter, & Carroll, 2002) reduced the reinforcing efficacy of drugs, as well as in human studies in which learning opportunities, personal comfort, and social success deterred participants from drug use (Carroll, Anker, & Perry, 2009). The notion that increasing the availability of substance-free reinforcers reduces drug use also can be implicated in an explanation of CM's effectiveness.

Another useful concept in a behavioral economic analysis of drug use is the relative reinforcing value (RRV) of one's drug of choice relative to other reinforcers. Researchers in the field of behavioral economics often operationalize RRV in terms of an individual's drug-related resource allocation and enjoyment relative to his or her resource allocation to and enjoyment of nondrug alternatives. Many researchers have suggested that RRV is a useful index of drug-problem severity (Correia & Carey, 1999; Tucker, Vuchinich, & Rippins, 2002). Specifically, research has shown that for individuals who engage in several reinforcing activities other than drug use, a small increase in drug-free alternative reinforcement curbs drug use relative to individuals who derive a large proportion of reinforcement from drugs and report few valued substance-free alternatives (Murphy, Correia, Colby, & Vuchinich, 2005). This finding suggests that if one intends to reduce drug use, it might be worthwhile first to increase the availability of alternative substance-free reinforcers, after which implementing a motivational intervention might be more effective. The data previously discussed, suggesting that variables such as marriage and hours worked per week correlate with reduced drug use, also support the notion that people are less likely to use drugs when the RRV of nondrug activities is high.

Alhough the practical, evidence-based solutions discussed above are compatible with a melioration framework, they do not require this framework. Instead, these solutions can be derived from more clearly defined accounts of addiction as choice (e.g., self-control and behavioral economic accounts). The notion that a melioration framework might be unnecessary for deriving concrete, demonstrably effective solutions for treating addiction is particularly relevant to a *JABA* audience, because applied behavior analysts emphasize the importance of developing and implementing conceptually systematic, practical treatments for problem behavior. It is important to note that the solutions derived from self-control and behavioral economics frameworks do not diminish the merit of the melioration framework, nor do they negate any treatment implications derived from melioration. In fact, approaching treatment with an understanding of all three models will maximize the number of interventions that a practitioner could potentially implement to reduce drug use. By discussing alternative frameworks, however, we have shown that the only unique approach to treating addiction that can be derived from melioration is that of teaching global bookkeeping.

In addition to approaching treatment with an understanding of three behavioral models of addiction (i.e., melioration, self-control, and behavioral economics), it also is useful to be aware of the neurophysiological influences on addiction. As we noted previously, neural variables can be incorporated into a functional analysis of operant behavior as establishing operations, antecedent stimuli, and reinforcers. Although applied behavior analysts are unlikely to manipulate biological variables when treating addiction, it is nonetheless worthwhile to be aware of the roles that these variables might play in a functional analysis of addictive behavior. Knowledge of biological variables will facilitate a richer understanding of addiction among behavior analysts.

Conceptualizing addiction as either a chronic, relapsing brain disease or as voluntary operant behavior has important implications for treatment and funding, and for how society responds to this problem. If addiction is a chronic, relapsing disease like diabetes or asthma, then society is obligated to treat addiction like diabetes or asthma (e.g., by researching and developing new pharmaceuticals). Thus, the disease model may be a pragmatic stance to obtain funding for research. However, understanding addiction as a disease might contribute to an "if-addiction-is a-brain-disease, we-must-train-the-brain" approach among scientists, policy makers, and practitioners that promotes pharmaceutical

interventions and undermines the demonstrated efficacy of behavioral interventions like CM. Conversely, if addiction is a choice, scientists and laypeople who hold a naive view of choice (e.g., viewing self-destructive choice as willful and irrational rather than caused by contextual variables) might view funding for research as unnecessary, supporting instead a legal response to the problem. For this reason, Heyman's argument for addiction as choice—in which addiction is self-destructive operant behavior controlled by contextual variables—is critical. This view permits scientists, policy makers, and practitioners to approach treatment in alternative pragmatic ways (e.g., manipulating environmental variables that precede drug use, increasing the costs associated with drug use, implementing CM in either residential or outpatient facilities, etc.) that research has already shown to be effective.

CONCLUSION

In this review, we have summarized the arguments made in Heyman's book, and we commend him for convincingly advancing an important, albeit controversial, view of addiction as choice. We have presented two additional models of addiction that magnify Heyman's arguments and provide additional organizing principles for the material that he discusses. By acknowledging the utility of all three models in a conceptualization of addiction as choice, a greater number of solutions for reducing addiction emerge. Specifically, whereas the melioration model suggests that teaching global choice will reduce addiction, self-control and behavioral economics models emphasize the importance of engaging in behaviors that produce alternative reinforcement. In any case, however one prefers to frame addiction, Heyman's argument still stands: Addiction is most usefully described as a disorder of choice.

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Received April 15, 2011
Final acceptance June 16, 2011
Action Editor, Cathleen Piazza